DOCUMENT RESUME

ED 171 579 SE 027 808

AUTHOR Yeany, Russell H.; And Others
TITLE The Effects of Diagnostic Prescriptive Instruction and Locus of Control on the Achievement and Attitudes of University Students.
PUB DATE Mar 79
NOTE 18p.; Paper presented at the annual meeting of the National Association for Research in Science Teaching (52nd, Atlanta, Georgia, March 21-23, 1979)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Biology; College Science; *Diagnostic Tests; *Educational Research; Higher Education; *Locus of Control; *Remedial Instruction; *Science Education
IDENTIFIERS Research Reports

ABSTRACT

This study looks at the effect of objective referenced formative diagnostic testing followed with remediation assignments on three cognitive levels of science achievement and the attitudes of university students, and determines if the effects of treatment were consistent across student locus of control levels. The subjects of the study were 60 university students enrolled in an introductory biology course at the University of Georgia. One group of students, following the normal course of study, received performance objectives which guided instruction and student evaluation. The second group received the same objectives and instruction. In addition, they completed regular diagnostic measures which were keyed to the objectives and received remedial assignments when necessary. This group achieved higher on the total achievement measure than the first group. No effects of locus of control on achievement were observed. (BB)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED171579

THE EFFECTS OF DIAGNOSTIC PRESCRIPTIVE INSTRUCTION AND LOCUS OF CONTROL ON THE ACHIEVEMENT AND ATTITUDES OF UNIVERSITY STUDENTS

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Russell H. Yeany

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Russell H. Yeany
Richard J. Dost
Robert Matthews

University of Georgia
Athens, Georgia 30602

March 1979

A paper presented at the
Annual Meeting of the
National Association
for Research in
Science Teaching

SE 027 808

THE EFFECTS OF DIAGNOSTIC PRESCRIPTIVE INSTRUCTION AND LOCUS OF CONTROL ON THE ACHIEVEMENT AND ATTITUDES OF UNIVERSITY STUDENTS

Traditionally, university students have been expected to guide and direct their own study efforts in order to acquire knowledge and skills related to a particular course or program. This view assumes that students can focus on the expected outcomes, diagnose their level of competence and engage in effective study and remediation when necessary. Recently, some university instruction has been centered around performance objectives which help clarify the expected outcomes. The next logical step in developing an instructional system, after providing students with performance objectives, is to develop a means for diagnosing student achievement and providing for feedback and remediation.

Combining the use of stated objectives, diagnosis and remediation provides the basis for the use of a diagnostic remedial instructional system which can be summarized as follows:

1) The instructor defines expectations in terms of student post-instruction outcomes (i.e., instructional objectives).

2) Test items are prepared that correspond to the instructional objectives.

3) Instruction is planned and carried out to help students achieve the objectives. Any materials may be used and any appropriate teaching procedures may be followed.

4) Diagnostic tests related to the objectives are given either before or after instruction or both. The tests are short and are given frequently so that learning problems are quickly identified.

5) Students are provided feedback on how they performed on the diagnostic tests. Remedial work is prescribed for students who do not achieve an objective.

6) Additional cycles of instruction--diagnostic testing--remediation may be carried out with either individuals or groups (conditions may preclude taking all students to mastery).

The methods of implementing a diagnostic remedial system of instruction vary with the specific nature of the application (e.g., the instructor may provide for remediation by reteaching or students may be given individual remediation assignments to complete). Diagnostic remedial systems can vary on both the dimensions of diagnosing and remediating. As indicated in Figure 1, these dimensions can vary from no formal activity to a fully structured individualized activity keyed to specific objectives.

(insert Figure 1 about here)

Some students may use this type of system to better advantage than others. For example, students who believe that they are in control of their own destiny may act upon the feedback provided by the diagnosis quicker than students who believe that their personal actions stand little chance of improving their achievement. Rotter (1966) defined the mental construct of "locus of control" (LOC) and designed an instrument to measure the trait and classify individuals as having an internal or external locus of control. Persons identified as "internal" believe that to a large degree their own actions determine their future; while, "external" individuals think that mostly chance or forces outside of their control determine what happens to them.

There is a significant amount of research which indicates that the use of diagnostic remedial strategies can positively influence achievement (see review by Block and Burns, 1976). No studies, however, have been reported on the possible treatment by aptitude interaction between this instructional strategy and the locus of control of the students. Also, few studies have examined the effects of diagnostic remedial instruction on various cognitive levels of achievement (e.g., Sheppard and MacDermot, 1970). Whether the system is better for one cognitive level

of learning (e.g., recall, comprehension and synthesis) is another question which needs to be researched.

This study was conducted to assess the effects of diagnostic prescriptive teaching strategies and locus of control on various cognitive levels of science achievement in freshman biology students, and to examine the interaction between the instructional strategy and students' locus of control. Another purpose of the study was to assess the influence of the above variables on students attitudes. The possibility exists that increased achievement may be brought about at the expense of attitude toward the instruction or the area of learning.

METHOD

Subjects

The subjects of the study were enrolled in two sections of an undergraduate biology course for preservice elementary teachers at the University of Georgia. Most were freshman or sophmore students. The subjects enrolled in the classes on a "first come, first served" basis and when the requested section was full the computer assigned the student to the other section. Any bias in enrollment may have been due to student preference for instructor (although the same instructor taught both sections during treatment administration) or time of day (i.e., one section met at 8:00 a.m. and the other at 10:00 a.m.). Through random assignment, the early class received the experimental treatment while the second class served as the comparison group.

Treatment Levels

The treatments were administered during a two week (two hours per session) unit on Organic Evolution. Both classes had studied the same topics using the same instructional procedures prior to the administration of treatment. The same instructor taught the experimental unit and the prior unit in both sections. This

was done in order to eliminate the internal validity threat of having different instructors in the experimental and comparison group. The treatment conditions experienced by the two groups are defined as follows:

COMPARISON GROUP: OBJECTIVES ONLY (O). The usual procedure in the biology course was to provide each student with performance objectives which guided instruction and student evaluation. The organic evolution unit consisted of 16 objectives. The subjects in this treatment level received the usual unit objectives and experienced instruction which included lecture-discussions, a slide tape presentation, two laboratory sessions and one homework assignment. The instructional procedures were not unique to the unit; the sessions were considered normal for the course.

EXPERIMENTAL GROUP: DIAGNOSIS AND PRESCRIPTION (DP). Subjects in this treatment level received the same performance objectives and instruction as the above group and followed an identical time schedule (i.e., 4-5 objectives per session). In addition, they completed regular diagnostic measures which were keyed to the objectives and received remedial assignment when necessary.

For each of the objectives, two remedial assignments had been preselected on the basis of appropriateness for a particular objective. Mostly these consisted of a short (i.e., one or two pages) reading assignment from sources other than the course text. But, activities such as viewing a film loop, listening to a tape or discussing a concept with an instructor were also included. A file folder was set up for each subject from which he obtained the diagnostic measure at the beginning of the session and the necessary remedial assignments at the end of the session. All reading assignments were photocopied and placed in the folder. Diagnostic quizzing required about 5 minutes with each student completing a short quiz which covered all objectives from the previous class session. If a student received a remedial assignment, he was rediagnosed on those objectives concurrent with the diagnosis for for the new subset of objectives. While the quizzes were marked by an assistant, daily instruction continued on schedule toward the next subset of objectives. Students were not required to master the objectives before the class proceeded. Also, no formal class time was taken to reteach an objective. Remediation was prescribed through the diagnostic remedial strategies but the responsibility of completion was left to the student.

In order to familarize the students in this group with diagnostic testing procedures; they were given a diagnostic test with immediate feedback but no remediation in the instructional unit prior to the experimental unit.

Data Collection

Pretreatment data were collected on the achievement of all subjects on three course achievement measures. Both sections received the same objective referenced examinations on all units. The mean of these three scores was used as a covariate in the statistical analysis to increse the power of the hypothesis testing and to adjust for selection bias that could be identified through prior achievement in the course.

Data on the locus of control were collected with the Rotter (1966) LOC measure during the week prior to treatment. Subjects who scored at or above the mean ($\bar{x}$ = 10) were identified as "internal"; others were identified as "external". The mean and dispersion of these scores corresponded with data collected in middle and high school science classes (Saunders, 1978 and Long, 1978).

Post treatment data were collected on the student achievement with an objective reference measure which was identified as a "unit test". The score on a unit test accounted for one-tenth of the grade for the course. This was the last of five such tests. The content validity of the measure was insured by assigning five biology instructors to write items for specific objectives at three taxonomic levels (i.e., recall, comprehension, and higher), and each item was reviewed by the entire group to assess how well it measured the objective at the stated level. Items which were identified as inappropriate were rewritten. The KR_{21} reliability estimate for the measure was .95.

Data were collected on the students attitudes toward the instructional procedures with an affective instrument composed of Likert type items. To measure attitudes toward specific characteristics of DP instruction, items which were unique to the experimental group were added to their measure. The attitude measures

were adapted from instruments used in a study by Waugh (1977).

Research Design and Analysis Procedures

The basic design for this study is quasi-experimental and can be diagrammed in Campbell and Stanley notation as follows:

$$\begin{array}{ccccc} O_1 & O_2 & X_a & O_3 & O_4 \\ \hline O_1 & O_2 & X_b & O_3 & O_4 \end{array}$$

The levels of treatment, the pre-measure, and the criterion measures, each of which have been discussed previously, are:

X_a The Objectives Only level (O)

X_b The Diagnostic Prescriptive level (DP)

O_1 The average of three course unit tests

O_2 The Rotter locus of control measure

O_3 The achievement measure for the experimental unit

O_4 The attitude assessment measure

The data were analyzed in a 2 x 2 factorial design with two levels of treatment and two levels of LOC (i.e., internal and external) using Analysis of Covariance procedures. The mean of the prior achievement scores served as a single covariate with the subject as the unit of analysis. All hypotheses were tested at the $\alpha = .05$ level.

RESULTS

The adjusted and unadjusted achievement group means for the total test and the three cognitive level subtests are given in Table 1. As can be noted, there was only slight adjustment in the means when prior achievement was used as a covariate.

(insert Table 1 about here)

The ANCOVA procedures indicated that, on the total criterion measure, the DP group achieved significantly higher than the objectives only group ($p = .04$) (Table 2). This difference represented a 10 percent increase in achievement in favor of diagnostic prescriptive instruction.

(insert Table 2 here)

When the cognitive level subtest data were analyzed the differences in achievement appeared to exist in the recall level items ($p = .05$) (see Tables 1 & 2). No other significant influences of treatment were found in the achievement results ($p > .05$), and no effects of Locus Control on achievement or LOC X treatment interactions were found ($p = .99$).

Although the mean attitude scores in all items were positive (Table 3), the analysis of the attitude data indicated that there were no significant differences in attitude which could be attributed to treatment effects on the total attitude measure or any sub-parts ($p > .05$) (Table 3). In relation to LOC, there were two significant differences which indicated that "internals" were more positive in their attitude toward the instructor and tests than "externals". ($p = .05$) (Table 3). One significant LOC X treatment interaction occured in the attitude toward instructor data (see Figure 2).

(insert Table 3 & Figure 2 here)

As mentioned earlier, data were collected on the experimental subjects attitudes toward DP instruction. It was not possible to compare these results with the subjects who had not received DP instruction but in an absolute sense, the mean responses were all positive. The subjects experiencing the experimental treatment recognized it as a valuable learning aid as evidenced by an average

response of 4.06 across 11 attitude items where 5 was optimum.

CONCLUSIONS AND RECOMMENDATIONS

The results of this study provide evidence that science achievement of university students can be increased with the use of diagnostic prescriptive instruction. Also, the greatest impact appears to be on low level learning (i.e., recall). This result needs to be the focus of further research because the intent of the diagnosis and remediation in this study was not to concentrate on low-level learning. All items on the criterion measure were represented by parallel items on the diagnostic measures. In fact, both sets of items were randomly drawn without replacement from the same pool.

If, as this study indicates, DP methods are most appropriate for causing gains in low-level learning, this needs to be recognized and the procedure used accordingly. Perhaps, other methods can then be employed to increase the higher level learning.

In relation to the lack of influence of locus of control on achievement and the lack of a treatment by locus of control interaction, these results seem to be counter-intuitive. As mentioned earlier, if the internal subject allows his locus of control to guide his behavior, the DP procedures should be differentially effective in favor of the internal subject (i.e., he should act more readily on the feedback and remediation opportunities). One possible explanation is that university student behavior is not guided by locus of control as measured by the Rotter instrument. The students study habits may not necessarily reflect their belief system (i.e., they may have learned that they must respond to feedback and remedial suggestions if they are to be successful). Students who do not respond may have been selected out in a process that begins in the high schools.

Although the attitudes were generally very psoitive, there were no significant differences in attitudes attributed to treatment. This is encouraging because the DP methods influenced a 10 percent increase in achievement through stimulating greater student effort or more efficient studying without a loss in the affective dimension. The LOC X treatment interaction across the attitude toward instructor data did indicate that when students experienced the diagnostic-remedial strategies, the external student had a slightly better attitude than the internal student. This effect was reversed in the comparison group (Figure 2). These results should not be over-interpreted, however, because the differences were small and all attitudes positive.

All modification in existing instructional procedures include costs in terms of time and effort. The case of DP instruction is no different but the probability of a benefit in increased achievement is high.

TABLE 1

Unadjusted and Adjusted Mean Biology Achievement Scores on The Total and Sub-Tests of University Students Across Treatment Levels and Locus of Control

		Total Test		Sub-Tests					
				Recall		Comprehension		Above Comprehension	
		$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
TREATMENT	Diagnostic Prescriptive	57.5	8.6	30.7	5.2	13.6	2.9	12.9	3.7
		58.0*		40.0*		13.7*		13.1*	
	Objectives Only	53.4	8.4	28.9	5.9	13.7	2.1	18.5	22.2
		52.9*		27.8*		13.6*		18.4*	
LOCUS OF CONTROL	Internal	56.5	6.7	28.6	6.7	13.5	2.5	16.0	16.6
		56.3*		28.7*		13.6*		15.4*	
	External	54.4	10.3	30.1	4.5	13.8	2.5	15.4	15.7
		54.6*		30.0*		13.7*		15.5*	

*Adjusted for selection bias on the average of three unit tests taken prior to treatment.

Table 2

Results of Analysis of Covariance Procedures on the Achievement Test and Sub-Tests S Across Treatment and Locus of Control

	Sources of Variation	df	Mean Square	F	P
TOTAL TEST	Treatment	1	294.75	4.27	.04
	LOC	1	34.81	0.50	.99
	T X LOC	1	1.14	0.52	.99
	Residual	43	69.10		
RECALL	Treatment	1	114.58	3.80	.05
	LOC	1	20.03	0.66	.99
	T X LOC	1	12.46	0.41	.99
	Residual	43	30.18		
COMPREHENSION	Treatment	1	0.09	0.01	.99
	LOC	1	0.61	0.10	.99
	T X LOC	1	4.15	0.65	.99
	Residual	43	6.44		
ABOVE COMPREHENSION	Treatment	1	328.25	1.22	.28
	LOC	1	2.18	0.01	.99
	T X LOC	1 =	2.31	0.01	.99
	Residual	43	269.43		

$\alpha = .05$

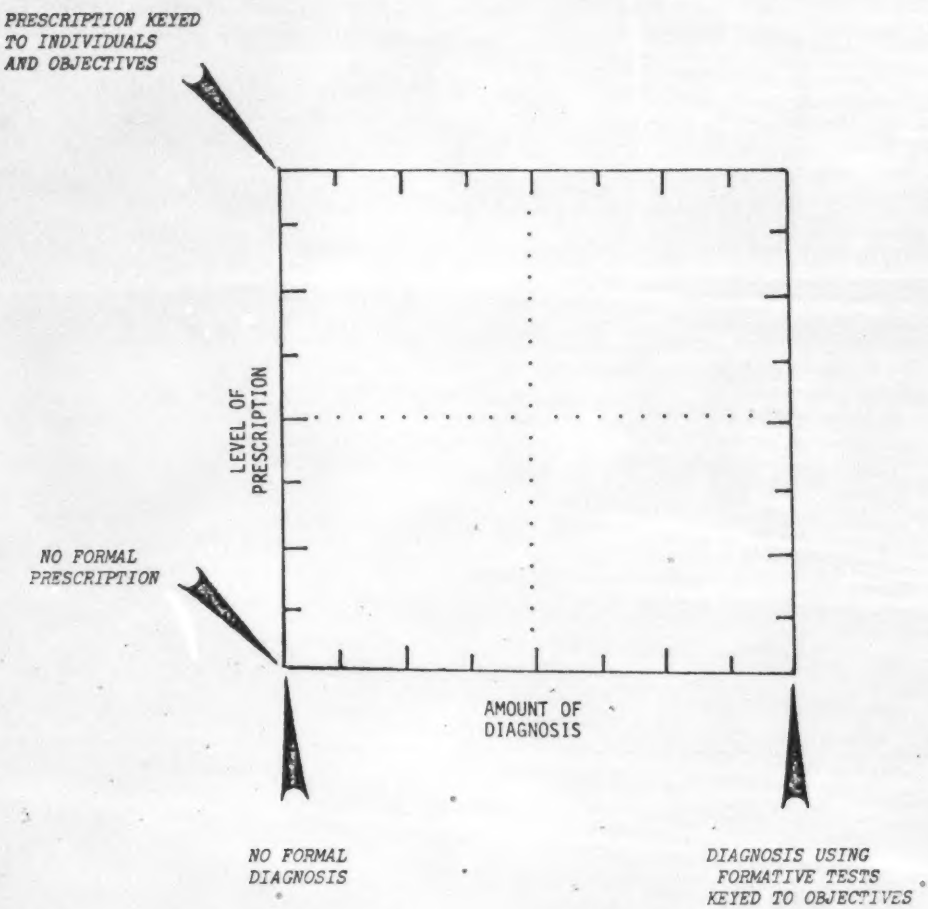
PRESCRIPTION KEYED TO INDIVIDUALS AND OBJECTIVES
LEVEL OF PRESCRIPTION
NO FORMAL PRESCRIPTION
AMOUNT OF DIAGNOSIS
NO FORMAL DIAGNOSIS
DIAGNOSIS USING FORMATIVE TESTS KEYED TO OBJECTIVES

Figure 1. A Diagnostic-Prescriptive Activities Model. Coordinates in each of the quadrants represent the nature of a specific D-P system.

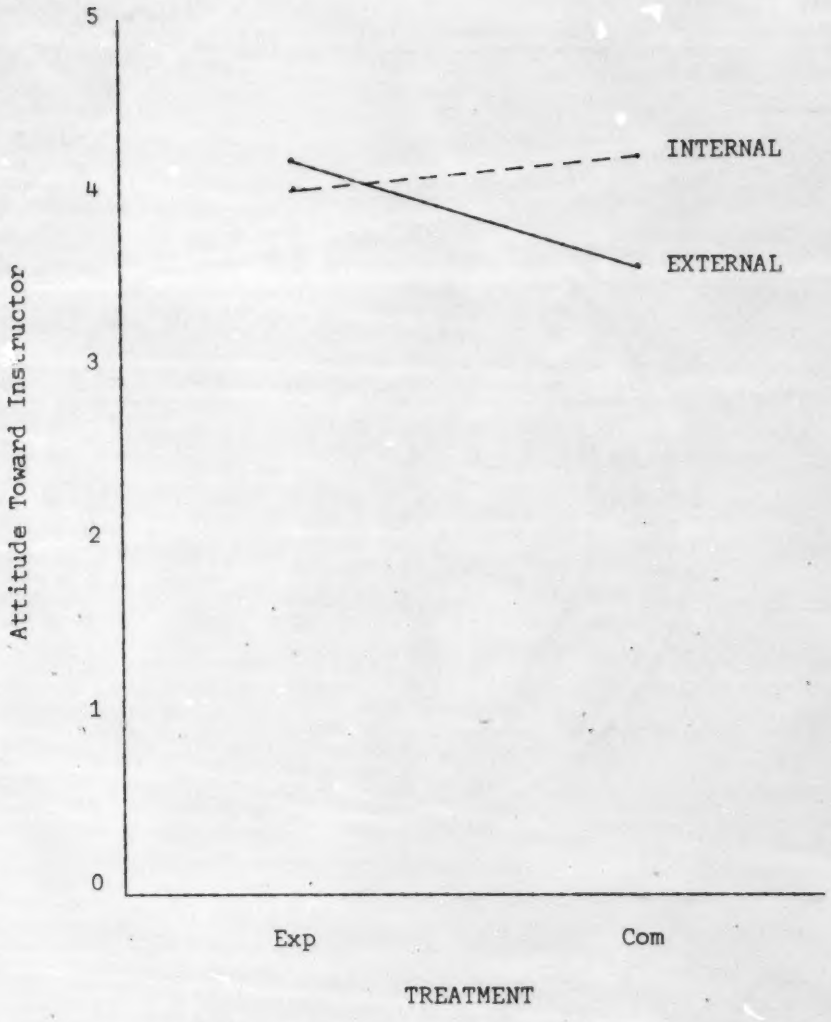

Figure 2. A representation of the interaction between Locus of Control and Treatment on the attitudes of students toward the instructor.

Table 3

Mean Responses and ANOVA Results of Attitudes Responses of University Students Across Treatment Levels and Locus of Control

ATTITUDE	TREATMENT GROUP MEAN*		F	P	LOC GROUP MEAN*		F	P	LOC X TREATMENT INTERACTION F	P
	Experimental	Comparison			Internal	External				
Instructor	4.21	4.01	1.8	.19	4.26	3.98	3.7	.05	5.0	.03
Objectives	4.30	4.30	.08	.99	4.40	4.24	1.4	.25	2.0	.15
Tests	4.14	3.83	3.2	.08	4.16	3.83	3.7	.05	.74	.99
Activities	3.87	3.83	.06	.99	3.81	3.89	.26	.99	.73	.99

*Based on a Likert scale where "5" was the optimum positive response.

BIBLIOGRAPHY

Block, J. H., & Burns, R. B. Mastery learning. In L. E. Shulman (Ed.), Review of research in education. Itasco: F. E. Peacock, 1977.

Long, J. C. The effects of a diagnostic-prescriptive teaching strategy on the achievement and attitudes of high school biology students. Unpublished doctoral dissertation, 1978.

Rotter, J. B. Generalized expectancies for internal versus external control of reinforcement. Psychological Monographs: General and Applied, 1966, 80 (1, Whole No. 609).

Saunders, R. L. The effects of diagnosis, remediation, and locus of control on achievement, retention, and attitudes of middle school science students. Unpublished master's thesis, University of Georgia, 1978.

Sheppard, W. C., & MacDermot, H. G. Design and evaluation of a programmed course in introductory psychology. Journal of Applied Behavior Analysis, 1970, 3, 5-11.

Waugh, M. L. The effects of diagnostic testing as a feedback mechanism on the achievement and attitude of students in an introductory college biology course. Unpublished master's thesis, University of Georgia, 1977.